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STRIGODERMA ARBORICOLA FAB.—ITS LIFE-CYCLE (SCARAB. COLEOP).

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*Contribution No. 59 from the Entomological Laboratory, Kansas State Agricultural College. This paper embodies some of the results of the investigations undertaken by the author in the prosecution of project No. 100 of the Kansas Agricultural Experiment Station.

INTRODUCTION.

Continuation of the work on the life-cycle of insects injurious to the roots of staple crops, begun at this station in 1916, has revealed the following life-cycle of *Strigoderma arboricola* Fab. This species of the family Scarabæidae, sub-family Rutelini, occurs somewhat generally throughout the state of Kansas. Popenoe (1877) records the beetles from western Kansas, and states that they are quite rare at Topeka. Casey (1915) gives the range of *Strigoderma arboricola* as occurring from New Jersey and Canada to Kansas. Only at rare intervals are they sufficiently abundant in Kansas to be of economic importance.

An opportunity to secure enough specimens to begin life history studies was afforded the writer by the collection of a number of the beetles by Prof. Geo. A. Dean at Abilene, Kansas, June 20, 1919. At this place they were found abundantly feeding on rose blossoms in a nursery where they were doing considerable damage. These beetles were brought to Manhattan where their subsequent life history was worked out. To date, the writer has been unable to find any reference to the life-cycle of this species in American literature.

The beetles were kept in large, covered tin pails containing damp soil. Various blossoms were fed to the adults and the soil examined daily after oviposition began. The freshly laid eggs were transferred to small depressions in closely packed soil in one ounce tin salve boxes where they were examined daily for hatching. Upon hatching, the young grubs were placed in individual salve boxes containing loose, damp soil, which was changed once or twice a week during the warm weather. They were kept constantly in a rearing cave (McColloch, 1917), where a somewhat constant temperature was maintained. The young grubs were fed bran until the second molt, when wheat grains were substituted. When the prepupal condition occurred, fresh soil was packed tightly in the salve box to approximate the natural condition of the pupal cell in which the transformations to the pupal and adult conditions took place.

FOOD PLANTS.

Hart and Gleason (1907, p. 244) record *Strigoderma arboricola* adults on flowers of clover, rose, *Opuntia humifusa* and *Monarda punctata*. Blatchley (1910, p. 986) records the beetles as occurring most commonly on flowers of wild rose, blackberry and the water willow, *Dianthera americana* Linn. The

following field notes are recorded by Vestal (1913, p. 45): "Notes taken June 24. The first *Strigoderma* was noticed a few days ago floating down the river. They are now excessively abundant on cactus, wild rose, red clover, timothy, elderberry, dewberry, dog fennel, *Verbena stricta*, wild parsnip, Monarda *punctata, Plantago, Saponaria, Tephrosia, Erigeron*. They are most abundant on prairie plants, being quite common in the bunch-grass association and along roadsides, very few being found in the forest'. July 3: '*Strigoderma* is still fairly abundant on different flowers. On July 6, a robber-fly, *Proctacanthus brevipennis*, was caught with a *Strigoderma* in its grasp, which it was in the act of eating." In Kansas, blossoms of wild and cultivated rose plants are apparently the preferred food of the beetles.

The grubs were not observed feeding in nature. However, the fact that they were reared on bran and wheat kernels in the same manner that the writer has reared Lachnosterna grubs seems to indicate that there is no apparent difference between the feeding habits of this species and those of the more common white grubs.

Life Cycle.

Adult.—The beetle is described by Blatchley (loc. cit.) as follows: "Oval, subdepressed. Head, thorax and scutellum dull blackish-green, shining; sides of thorax usually in part or wholly pale; elytra dull brownish-yellow, often suffused with fuscous or piceous, especially on the sides and along the suture; under surface and legs piceous, sparsely clothed with long grayish hairs. Head coarsely, roughly and confluently punctured. Thorax one-half broader than long, sides feeble curved, hind angles rounded, front ones acute; surface coarsely, shallowly and rather sparsely punctate, with an impressed median line on middle third and two irregular depressions on each side. Elytra with all the striæ distinct, entire and deeply impressed. Length 10-12 mm."

He further states that two specimens observed had the thorax, elytra and legs wholly reddish-yellow and others had the thorax wholly bluish-black. The beetles occur on blossoms from May to July, where mating probably occurs.

A collection of 53 specimens made July 9, 1885, in Wallace County, Kansas, indicates their relative abundance in western Kansas during July. Specimens in the Kansas State Agricultural College collection from Columbus, Ohio, bear a September label. The females enter the soil to oviposit and die soon afterward. Egg-laying occurs during June and July.

Egg.—The egg is oval in shape and nearly pearly-white in color. It is about 2 mm. long and 1.2 mm. wide when freshly laid. The eggs increase slightly in size with age and assume a more globose form until immediately preceding hatching, when they are about 2.5 mm. long and about 2 mm. wide. Hatching occurs early in July.

The following table shows the length of the egg stage as observed:

TABLE 1.—LENGTH OF EGG STAGE.

Date Laid 1919	Date Hatched 1919	Length of stage days	Date Laid 1919	Date Hatched 1919	Length of stage days
June 27	July 9	12	June 27	July 10	13
"	"	"	"	"	"
"	"	"	"	"	"
"	"	"	"	"	"
"	"	"	"	"	"
"	"	"	"	"	"
"	"	"	"	"	"
"	"	"	"	"	"
"	"	"	"	July 11	14
"	"	"	July 12	12	10
"	"	"	"	13	11
"	"	"	"	" "	11
"	July 10	13	"	" 14	12
"	"	"	"	" "	"
			Average		12.2
			Maximum		14.
			Minimum		10.

Larva.—The larva resembles the common white grubs. No definite characters separate it from Lachnosterna grubs. There is, as in Lachnosterna, a triangular patch of hairs on the last ventral segment with a median double row of mesad pointing spines. The head is light brown or tan.

Before hatching the grub can be seen within the egg. When freshly hatched the head is white, except the tip of the mandible, but soon the whole head darkens to its characteristic color. Newly hatched larvæ are about 4 mm. long. As before stated, hatching occurs early in July, and the winter is passed in this stage. The following spring the prepupal condition is reached and pupation soon occurs. The length of the larval and prepupal stages of four individuals raised to maturity are shown in table 2.

TABLE II.—LENGTH OF LARVAL STAGE.

Egg Hatched	Became Preputa	Length of stage to prepupa days	pupated	Length of prepupal stage days	Length of complete larval stage days
July 7, '19	May 26, '20	321	June 2, '20	7	328
July 10, '19	May 24, '20	319	June 2, '20	8	327
July 10, '19	May 31, '20	325	June 6, '20	6	331
July 13, '19	May 25, '20	322	June 29, '20	4	326
Average		321.7		6 2	328
Maximum		325		8	321
Minimum		319		4	326

Pupa.—The pupæ are from 10 to 12 mm. long. When freshly transformed they are creamy-white but they gradually darken as the adult colors are assumed. The four grubs reared to pupation, as noted in table II, were likewise successfully reared to adults. Their period of pupal life is shown in table III.

TABLE III.—LENGTH OF PUPAL STAGE.

Date Pupated	Date Adult	Length of Pupal stage days
June 2, 1920	June 14, 1920	12
June 2, 1920	June 13, 1920	11
June 6, 1920	June 20, 1920	14
May 29, 1920	June 12, 1920	14
Average		12.7
Maximum		14
Minimum		11

SUMMARY.

The beetles of *Strigoderma arboricola* occur during May, June, and July. Egg-laying occurs in June and July. The eggs hatch in from 10 to 14 days, and the grubs pass the winter in the soil, requiring an average of 321.7 days to reach the prepupal condition which in turn requires 4 to 8 days, making an average combined larval stage of 328 days. The prepupal stage varies in length from 11 to 14 days with an average of 12.7 days. The four individuals reared to maturity, with their egg stages added, required 351, 352, and 358 days for complete development.

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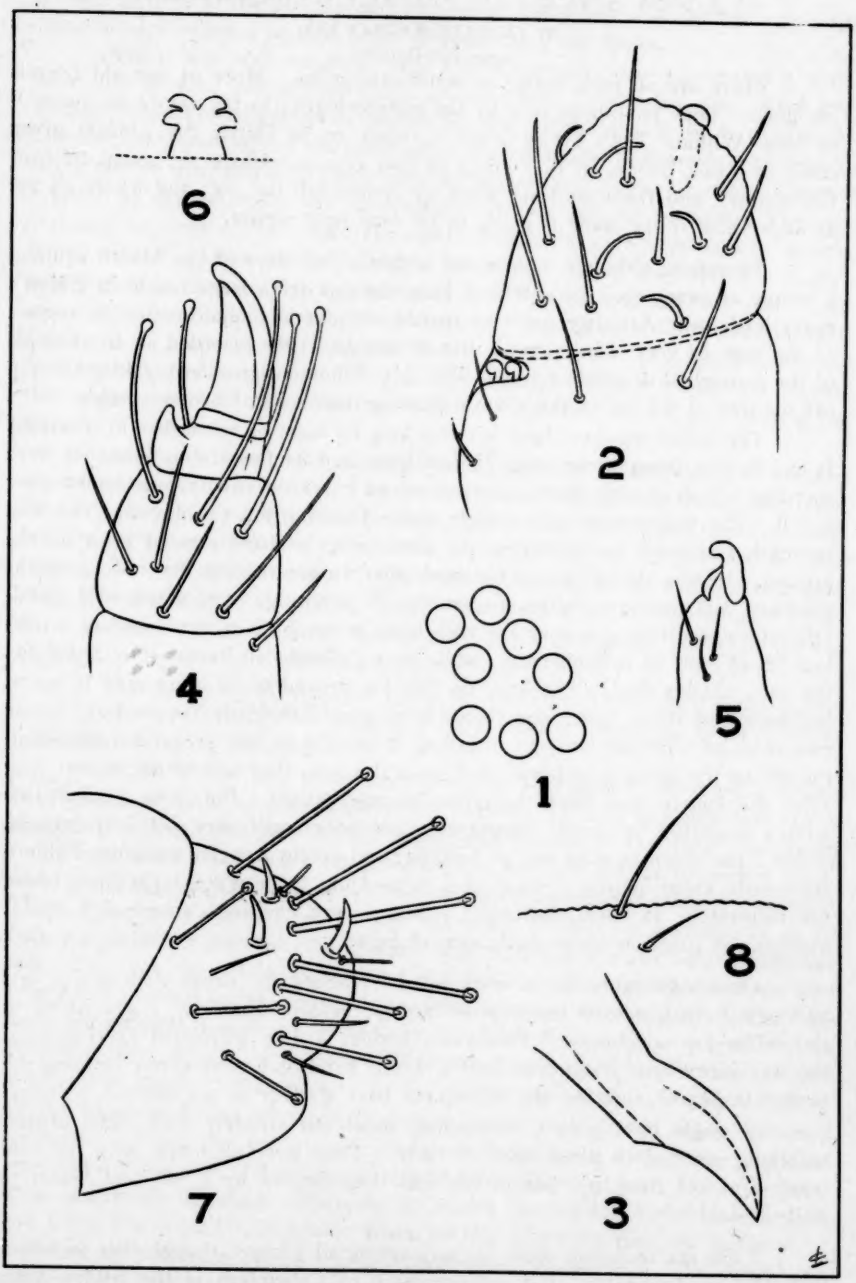
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A NEW SPECIES OF FRIESEA (COLLEMBOLA).

BY CHARLES MACNAMARA,
Arnprior, Ontario.

There are no such things as equinoctial gales. More of our old friends are gone. They have been sent by the metereologists to try vainly of course—to blow William Tell's arrow from its mark or to flutter the Lincoln green cloak of Robin Hood, in that limbo of lost illusions where the moon controls the weather, and fixes the time when we should kill the pig; and where all the animals know if the snow is going to be deep next winter.

Therefore, although it occurred within a few days of the March equinox a couple of years ago, the gale that blew the top off a large maple in Elliott's sugar bush near Arnprior must be named without any qualification in respect of the time of year it happened. But it may be fairly recorded as an example of the proverbial ill wind; for if it blew Mr. Elliott no good in breaking the top off his tree, it led me to the always pleasing discovery of a new species.

The fallen top was about ten feet long by eight or ten inches in diameter. It had broken from a tree some 75 feet high, and its few stubby branches were smashed off in coming down. I chanced on it within twenty-four hours after it fell. The temperature was a little above freezing, but the day was raw and overcast, and there was still three or four inches or hard crusted snow on the ground. It was the moss on the bark that first attracted me. Moss means moisture, and moisture means springtails. It is strange how enormously standards of value differ. A dozy log with loose mossy bark is an absolutely worthless "dead cull" to a lumberman, while to a Collembolan hunter it is a delightful and valuable find. The bark on this log proved to be loose only in spots, but here and there under the flakes were considerable numbers of the white cast skins of Collembolans, an unfailing indication of the gregarious kinds, although as the skins may persist for several years, they are often present long after the colony that shed them has become extinct. But close examination with a magnifier presently discovered some very small slow pellid springtails, which I put down as a species of Xenylla; and young Xenylla maritima Tullb.—apparently about quarter grown—they turned out to be when I got them under the microscope at home that night. Not a very exciting capture this, as X. maritima is common under bark around here.

On a cold rainy day a week later I reached the sugar bush again; and although it had yielded nothing of interest before, somehow I gravitated to the fallen top once more. This time, besides a few additional specimens of the tiny Xenyllans, I captured half a dozen handsome olive-green Isotoma determinata MacG., another not infrequent bark dweller in my district. Then I found a single light grey Collembolan, small but strongly built, and further searching resulted in three more of them. They were all numb with the cold when I picked them up, but in the vial they livened up a bit, and began to walk around.

I did not recognize them for any springtail I knew, though they looked a little like an Achorutes. But determination of Collembola in the field is very uncertain, and two or three times my supposed prize has turned out to be only

another variety of the protean and ubiquitous *Achorutes armatus* Nic. So these unknown specimens I carried home without any great hopes.

And it was with no more than a mild curiosity that I prepared a specimen that evening for microscopical examination. The color that looks grey under the pocket magnifier is shown by the microscope to be a pale violet. Unguiculi are wanting, so the insect does not belong to the *Achorutes*, that genus being always provided with these little supplementary claws. A drop of potash solution is drawn under the cover-grass to clear up the pigment. The eyes can now be counted, and there are eight of them on each side, and no postantennal organs. Then suddenly interest flares up. *Three anal spines!* A hurried search in Guthrie and Folsom—this is a *Friesea*, and the only one of the genus ever recorded in North America before was described by Guthrie, who, finding it in a greenhouse, suggests that it is an exotic. My species does not fit Guthrie's description, and living at the top of a 75 foot maple in a locality that might almost be called the backwoods, it certainly cannot be anything but a native Canadian.

The next care was to get more specimens, and the following day I searched the fallen top for two hours and found two more; rate: one specimen per hour. The top was close to Mr. Elliott's sugar-house, and as he was making ready for the spring sap-boiling, I was afraid he might cut up my precious log for fuel, so I asked him to spare it. He readily agreed, albeit with an indulgent smile that might greet the naive request of a child or a slightly demented person. But my precautions were unnecessary, for I completely unbarked the log without finding a single additional specimen on it.

I searched also in vain the trunk of the tree from which the top had fallen and many other trees around. They yielded numerous other Collombolans but no more Frieseans.

Nor did I find any more anywhere else all summer, although I looked for them in all kinds of places, likely and unlikely. It was not until late in the autumn that they came into my life again; and strange to say, they were again found in a fallen maple top. On the 26th October fate led me through a hardwood grove 300 or 400 yards to the east of the sugar-bush of original discovery. There I noticed a maple lately broken off about 40 feet up, and the 15 or 20 foot top, with its butt on the ground was standing upright against another tree. The nice loose-looking bark of the broken piece appealed to me, and I began to pry pieces off, and examine them with my watchmaker's glass. Almost immediately I saw my Friesea again. This time they were gathered in groups of five or six, and many individuals were much larger than any of those I had taken in the spring. In the course of the next few days, before all the loose bark was removed, I collected here with delight 30 or 40 good specimens. After the poverty of six small individuals that I had suffered from before, this was affluence, and should have contented me. But no collector is ever really satisfied. There *is* no wealth beyond the dreams of avarice, and I felt like John D. Rockfeller when he had saved his first ten millions.

And so the quest of the *Friesea* continued. Numerically, the subsequent results have been poor, only two specimens having been collected during the past year. But the remarkable feature of this, the third separate discovery of

the species, was that the insects were again disclosed living at the top of a maple tree. The two specimens were taken from under the bark of a short thick branch, lately fallen, like the first broken top, from the summit of a large maple in Elliott's sugar-bush.

In each instance the conditions under which the insects were found precluded any chance of their having made their way from the ground onto the fallen piece after it had come down. They had certainly been living in the tops of the trees. Of course, numerous Collembolans live all over trees from root to crown wherever there may be a little moisture or rotten wood; but this species appears to live in the tops only. However, I can see no good reason why this should be their only habitat, and it is probable that eventually they will be found in lowlier stations.

As appropriate to their apparent predilection for high places, the species is named "sublimis", the word—which was kindly suggested to me by Mr. F. J. A. Morris of Peterborough—being used in its primitive sense of "raised up."

The genus *Friesea* Dalla Torre comprises only five described species including the subject of this paper. The discovery of the present species necessitates a few changes in the generic description which should now read as follows:

Genus **Friesea** Dalla Torre

Eyes eight on each side as a rule; five on each side in *F. decemoculata* Borner. Postantennal organs absent. Antennae four-segmented. Mandible without molar surface. Head of maxilla simple. Unguiculi absent. Furcula short, weakly developed in most species; well developed in some species; mucro hooklike. Anal spines three. Anal segment small; supra-anal valve rounded semi-globose. Body without segmental tubercles, cuticula tuberculate.

Friesea sublimis, n. sp.

Color, pale lilac on silvery white ground, the head being slightly darker than the body; under parts lighter and body sutures white. *Eyes,* (fig. 1) eight on each side. No postantennal organ. *Antennae* (fig. 2) subconical, three-quarters length of head; third and fourth segments confluent dorsally but suture shows ventrally; fourth segment with five or six thick curved olfactory setae as well as many straight, tapering hairs; stout capitate protusible sense organ in a deep pit on apex just inside median line, another sense organ of two thick hooked members distally in a recess on outer side of third segment. *Maxilla* (fig. 3) with simple head and acute apex. *Mandible* with several distal inner incisive teeth and no molar surface. *Unguis* (fig. 4) stout, curving, untoothed; unguiculus represented by a rounded lobe only; front feet usually with four knobbed tenent hairs, and mid and hind feet with five such hairs, but sometimes the hairs immediately above these are knobbed also making a total of six, seven or eight tenent hairs; tibiotarsus with a distal subsegment. *Furcula* (fig. 5) not rudimentary, but short, not reaching to second abdominal segment; dentes not reduced, stout, with three dorsal setae; mucro one quarter length of dens, with strong apical hook and prominent rounded lamella. *Tenaculum* bidentate,

in outline as fig. 6. *Anal spines,* (fig. 7) three in a triangle, with proximal base and distal apex, slightly curved, sharp, three-fifths length of hind ungues, on low papillae. The anal and genital segments bear many long straight setae with conspicuous round heads, and a few simple setae interspersed. ***Clothing*** (fig. 8) a few short curving setae. *Integument* finely tuberculate. Maximum length, 1 mm. Found under bark, April and October, near Arnprior, Ontario.

Compared with the powerful springing apparatus of an expert leaper like *Isotoma palustris* Mull., the furcula of *Friesea sublimis* appears small and weak. Nevertheless it is much better developed than in any other known member of the genus, and it is that that chiefly distinguishes the new species. The furculas of all other described Frieseans are little more than rudimentary, but with F. sublimis, though short, it is actually functional, and I have seen them leaping a distance of two or three inches, though they seldom indulge in the practice. The maxilla as shown in fig. 3 is a conspicuous object in the head when the specimen is depigmented.

As usual, I am much indebted to Dr. J. W. Folson of the University of Illinois for advice and assistance in describing this species.

EXPLANATION OF PLATE V.

Fig. 1. Eyes of left side, x 600
2. Left antenna, x 1200
3. Maxilla, x 900
4. Left hind foot, x 1500
5. Dens and mucro, x 1000
6. Tenaculum in outline x 1500
7. Anal segment showing spines and capitate setae, x 800
8. Clothing of first abdominal segment, x 1000

MISCELLANEOUS STUDIES IN THE COLEOPTERA— NO. 1.

BY FRANK E. BLAISDELL, SR.
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The following new species and races of American Coleoptera were found among a number of other species recently submitted to me for identification.

Listrus provincialis, New Species

Form oblong-ovate, about three times as long as wide and slightly robust.
Colour black; mouth-parts, antennae and tarsi more or less piceous; second antennal joint frequently paler.

Pubescence moderate in length, recumbent, linear and subsquamiform, quite dense and argenteo-plumbeous to luteo-cinereous in colour. Dark hairs arranged as follows: basal parascutellar and humeral macules very small or obsolete; post-basal macule at middle of each elytron, small and irregularly rounded; a rather slender transverse submedian fascia slightly behind the middle, zic-zac, and scarcely attaining the lateral margin or suture; subapical fascia similar or broken into two macules on each elytron; apical macules very feebly indicated or obsolete. Median pronotal macule more or less broken into four parts, two small anterior dots and two larger and slightly elongate, posterior dots; lateral

semilunar vittae feeble or more or less obsolete, sometimes represented by a small rounded macule; central area of the frons slightly darker.

Head subquadrate, moderate in size, broadly and very feebly impressed between the eyes, densely indentato-punctate, with a small rounded, glabrous convexity opposite the middle of the base of the clypeus. Eyes moderately large, and rather prominent, quite broadly convex and entire. Antennae similar in the sexes, extending to about one joint beyond the pronotal base; rather stout, outer joints moderately compressed, second oval and not stout, about as wide as long, third cylindro-obconical, about twice as long as wide, fourth as long as wide, subtriangular, fifth distinctly wider than the preceding and slightly wider than the three following joints, a little longer than wide and subtriangular; succeeding joints scarcely serrate anteriorly, sixth to the eighth subequal in size, triangular, anterior angle more obtuse than that of the fifth, ninth a little larger and stouter, obtusely rounded anteriorly, triangular, scarcely transverse, tenth still wider, slightly transverse and triangular, eleventh obovate, about twice as long as wide and compressed at apex.

Pronotum about a fourth wider than long, rather strongly and evenly convex from side to side; apex broadly and feebly arcuate in circular arc; sides quite broadly arcuate in basal two-thirds, thence feebly convergent to apex, more abruptly so at base, the latter broadly and not strongly arcuate, distinctly sinuate laterally into the rounded or obtuse basal angles; apical angles rounded; disk densely indentato-punctate, laterally indentato-punctato-reticulate. Lateral fimbriae moderate in length and backwardly curved, serrulations small and unequal in size.

Elytra oblong, rather parabolically rounded at apex, a little more than twice as long as wide; feebly convex at the disk, rather strongly so laterally; punctures rather close, somewhat coarse, separated by a distance equal to about twice their diameter; surface more or less granulato-reticulate, punctures somewhat impressed, intervals almost transversely prominent; humeri not at all prominent, rounded and obtusely rectangular.

Abdomen densely and finely reticulato-punctulate, fifth segment more strongly so. Apex of abdomen rather densely clothed with moderately long brownish or blackish hairs in both sexes.

Legs moderate in stoutness and length.

Male.—rather more oblong and less arcuate at the sides; fifth ventral segment truncate and distinctly sinuate at apex but not deeply so.

Female.—More ovate, sides more arcuate; fifth ventral rather strongly rounded at apex.

Measurements.— Length, 2.8-3 mm.; width, 1-1.1 mm.

Holotype, male, and *allotype,* female, to be deposited in the National Collection at Ottawa. *Paratypes* in the collection of Mr. Ralph Hopping and that of the author.

Type locality.—Spious Creek, near Merritt, B. C. Collected on May 23rd, 1920. Mr. Hopping has also taken it at Midday Creek, B. C., collected July 13th, 1920.

I cannot consider that Casey's *Listrus plenus,* taken on Vancouver Island, is the same as the present species for the following reasons: In *plenus* (female)

the antennae are slender, pronotal disk deeply and very closely perforato-punctate, interstices narrow, sparsely and feebly punctulate; pubescence denuded in *large irregular areas* on the elytra. In *provincialis* the antennae are moderately stout, pronotal disk densely indentato-punctate, intervals mere lines between the punctures and indentations, and finally the elytral dark pubescent areas are in well defined *small macules* or macules and narrow fasciae.

Eleodes (Litheleodes) extricata var.utahensis n. var.

Form fusiform-ovate to ovate, moderately strongly convex. Colour black, dull in lustre and alutaceous; surface smooth and the sculpturing feeble.

Head and pronotum finely punctulate, rather densely so on the frons. Antennae rather slender.

Pronotum slightly wider than long, evenly convex, punctures not denser laterally; apex truncato-sinuate in circular arc, angles subacute and somewhat prominent anteriorly; sides broadly and about equally arcuate from apex to base, marginal bead very fine; basal angles obtusely rounded; base broadly arcuate; apex and base almost equal in width.

Elytra oval, base broadly and feebly sinuate, scarcely wider than the contiguous base of the pronotum; humeri subacute, not at all prominent nor exposed; sides broadly and evenly arcuate to apex, gradually oblique to the obtuse apex; disk moderately convex, rather broadly arcuate laterally into the somewhat inflexed portion; punctures fine in closely placed longitudinal series, more or less confused laterally and on the inflexed sides and apical declivity.

Abdomen feebly and sparsely punctulate; obsoletely rugulose on first two segments.

Legs moderately long and rather slender.

Male.—Narrower. Anterior femora with an obtuse salient. Abdomen moderately convex and horizontal. Anterior tarsi without tufts of pubescence on the first joint at tip beneath, plantar grooves open on all the joints.

Female.—Broader, ovate. Abdomen rather strongly convex.

Measurements.—Length, (types), 16.5-16 mm.; width, 5.3-6.0 mm.

Holotype, female, and *allotype*, male, in the author's collection; *paratypes* in that of Mr. Warren Knaus.

Type locality.—Milford, Utah. Collected by Mr. Warren Knaus at an elevation of 4900 feet, on June 29th, 1919.

The differential characters are, the dull alutaceous lustre, smooth surface, fine inconspicuous punctuation and slender antennae. In typical *extricata* Say, also in the race *cognata* Hald., the plantar groove on the first joint of the anterior tarsi is closed at tip by a small tuft of golden pubescence. This tuft is absent in the male of *utahensis*. The latter race should precede the race *cognata* in our lists.

Eleodes (Litheleodes) vandykei variety modificata n. var.

Similar to *vandykei*, except that the elytra are moderately coarsely muricato-rugose throughout, with intermixed punctures. Form rather more ovate than in *vandykei*. Recent studies have lead irresistably to the conclusion that *vandykei* is a distinct species and not a race of *letcheri* Blais.

Measurements.—(Male and female). Length, 14-14.5 mm.; width, 6-7.3 mm.

Holotype, male, and *allotype,* female, to be placed in the National Collection at Ottawa. *Paratypes* in the collection of Mr. Ralph Hopping and that of the author.

Type locality.—Vernon, B. C. Collected April 6th, 1920, by Mr. Ralph Hopping. The elytral sculpturing in *modificata* is almost like that seen in *Eleodes cuneaticollis* Casey.

The following tabulation of characters will help in the recognition of *letcheri* and *vandykei* with its races:

Elytra muricately punctate.....1
Elytra more or less muricato-granulate.....3
1. Elytra sparsely pubescent with rather long flying hairs.....*letcheri* Blais
. Elytra with short setae.....2.
2. Elytra densely and muricately punctured, minutely so on the dorsum .....*vandykei* Blais.
-. Elytra densely and moderately strongly muricato-rugose with intermixed punctures .....var. *modificata* n. v.
3. Size usually smaller, pronotum relatively smaller and quadrate; granules subtuberculate and more or less arranged in evident longitudinal series.....var. *parvula* Blais.

In *parvula* the pronotum is noticeably smaller, more quadrate, with the sides less arcuate and parallel.

The species of the subgenus *Litheleodes* may be arranged in the following sequence:

Eleodes (*Litheleodes*) *arcuata* Casey.
extricata Say.
Var. *convexicollis* Blais.
var. *utahensis,* new variety.
var. *cognata* Hald.
var. *arizonensis* Blais.
granulata Lec.
var. *obtusa* Lec.
var. *corvina* Blais.
papillosa Blais.
letcheri Blais.
vandykei Blais.
var. *parvula* Blais.
var. *modificata* Blais.

NEW NEARCTIC CRANE-FLIES (TIPULIDAE, DIPTERA). PART XI.

BY CHARLES P. ALEXANDER,

The types are preserved in the collection of the writer unless stated otherwise. The material from Idaho is preserved in alcohol; paratypes of certain of these species are placed in the collection of the United States National Museum at the request of Mr. Shannon.

Limnophila (Idioptera) shannoni, new species

General coloration (in alcohol) dark brown; coxae and trochanters light

yellow; wings greyish yellow, the cross veins and deflections conspicuously seamed with greyish brown; male hypopygium with the outer pleural appendage simple.

Male.—Length about 6.5 mm.; wing 8 mm.

Female,—Length 7.8 mm.; wing 8.4 mm.

Described from alcoholic material.

Rostrum and palpi dark brown. Antennae of the male long, if bent backward extending about to the base of the abdomen; scapal segments pale yellowish brown, the flagellum dark brown. Head dark brown, the genae paler.

Thorax dark brown, with no stripes evident in alcoholic material. Halteres pale, the knobs a little darker. Legs with the coxae and trochanters light yellow; femora yellow, broadly tipped with dark brown; tibiae brownish yellow; tarsi pale brown. Wings with a faint greyish yellow tinge, the wing-base and the costal and subcostal cells more yellowish; stigma oval, dark brown; conspicuous greyish brown seams at the origin of R_R; at Sc_2; along the cord and outer end of cell 1st M_3 and along the supernumerary crossveins; veins dark brown. Venation: Sc_2 some distance from the tip of Sc_1, this distance slightly variable; R_1 bent caudad at R which is inserted on R_2 a little more than its own length beyond the fork and on R_1 about its length from the tip; R spurred at origin, in alignment with R_{2+3}; basal deflection of R_{4+5} and R in oblique alignment; petiole of cell M_1 much shorter than this cell; basal deflection of Cu_1 slightly before midlength of cell 1st M_2.

Abdomen dark brown. Male hypopygium with the pleurites stout; two pleural appendages, the outer appendage simple, narrow at the base, gradually widened to the squarely truncated apex, the outer margin and apex provided with numerous small appressed spines; inner pleural appendage a little longer than the outer, gradually narrowed to the bluntly rounded apex, the surface provided with setae.

Habitat.—Idaho.

Holotype, ♂, Moscow Mt., July 25, 1920 (R. C. Shannon).

Allotopotype, ♀.

Paratopotypes, 1 ♂, 1 ♀, the latter teneral.

This species and the next are of very considerable interest as being the first American representatives of the group typified by *L.* (*I.*) ***trimaculata*** (Zett.) of northern Europe. The genitalia are of a structure that differs in several respects from that of the type of the subgenus *Idioptera,* however, and it may be that all these species are not true members of *Idioptera.* It is with great pleasure that this interesting fly is dedicated to Mr. Shannon as an appreciation of his kind help in collecting Tipulidae in various parts ot the United States.

Limnophila (Idioptera) bifida, new species.

General coloration (in alcohol) brownish black; coxae and trochanters obscure yellow; wings dusky grey, the stigma slightly darker; no distinct darker markings on the wing; male hypopygium with the outer pleural appendage profoundly bifid.

Male.—Length about 5 mm.; wing 6 mm.

Female.—Length about 6.5 mm.; wing 6.7 mm.

Described from alcoholic material.

Head, rostrum and palpi brownish black. Antennae brownish black, the distal segments a little paler, if bent backward extending to (♀) or beyond (♂) the wing-root; flagellar segments in the ♂ rather elongate.

Mesonotum and pleura dark brown, the dorso-pleural membranes paler. Halteres elongate, pale, the knobs slightly darker. Legs with the coxae and trochanters obscure yellow; remainder of the legs light brown, the tips of the femora and tibiae slightly darker. Wings with a strong dusky grey tinge; wing-base slightly yellowish; stigma oval, darker grey; exceedingly faint markings at the origin of R and along the cord; veins dark brown. Venation: S_c long, S_{c^1} extending to about four-fifths the long R_s, S_{c^2} removed a short distance from the tip of S_{c^1}; R_s long, strongly arcuated at origin, in alignment with R_{2+3}; R_{2+3} rather long, about twice the deflection of R_{4+5}; very faint; veins R_3 and R_5 divergent; cell R_2 at the margin wider than either cells 2nd R_1 or R_2; petiole of cell M_1 about as long as the cell; basal deflection of Cu_1 at about one-third the length of cell 1st M_2; supernumerary crossvein in cell M a short distance beyond the origin of R_s.

Abdomen dark brownish black. Male hypopygium with the ninth tergite bifid, the lobes narrowly rounded at their tips and provided with blackened spines; pleurites short and stout, the apex of each produced into a flattened lobe; outer pleural appendage very broad, profoundly bifid, the dorsal blade flattened, with the inner margin provided with four or five appressed acute teeth; the ventral blade is narrower, a little shorter, at the tip with a few acute erect spinules; inner pleural appendage flattened, very short and high, rapidly narrowed to the blunt apex, provided with numerous setae. Ovipositor long and slender, the tergal valves upcurved, horn-color.

Habitat.—Idaho.

Holotype, ♂, Moscow Mt., July 25, 1920 (R. C. Shannon).

Allotopotype, ♀.

Rhaphidolabis (Rhaphidolabis) subsessilis, new species.

General coloration (in alcohol) brownish yellow, the praescutum with a conspicuous dark brown stripe; antennae with twelve segments; wings subhyaline; stigma faintly darkened; cell R_2 sessile or subsessile; abdomen dark brown.

Male.—Length about 5.2 mm.; wing 6.7 mm.

Female.—Length about 6.5 mm.; wing 7.4 mm.

Described from alcoholic material.

Rostrum and palpi brown. Antennae with twelve segments, dark brown, the last segment one-half longer than the penultimate. Head dark brown.

Pronotum obscure brownish yellow, broadly dark brown medially. Mesonotum brownish yellow, the praescutum with a conspicuous median dark brown stripe that is narrowed behind, ending before the suture; lateral stripes very indistinct. Pleura brownish yellow. Halteres pale, the stem darker. Legs with the coxae and trochanters brownish yellow; remainder of the legs brown, the tarsal segments darker. Wings subhyaline, iridescent, the stigmal area faintly brownish; veins dark brown. Venation: R moderately elongated, strongly arcuated; cell R_2 sessile to very short petiolate; outer deflection of R_3 less than its own length from the tip of R_1; cell 1st M_2 open; cell M_1 present, the branches

that enclose it widely divergent.

Abdomen dark brown, paler laterally. Male hypopygium with the distal lateral angles of the pleurite provided with numerous blackened spines; proximal face of pleurites with long, erect bristles; two pleural appendages, these short and stout, approximately equal in size, the outermost clavate, the head with numerous black spicules; inner appendage pale, the apex broadly and obtusely rounded. Lateral gonapophyses long and slender, approximately as long as the pleurites themselves.

Habitat.—Idaho.

Holotype, ♂, Moscow Mt., July 25, 1920 (R. C. Shannon).

Allotopotype, ♀.

Rhaphidolabis subsessilis is closely related to *R. rubescens* Alex. (Northeastern North America) but is readily told by the presence of but twelve antennal segments, the coloration and the elongate lateral gonapophyses of the male hypopygium. In its general appearance it is more like *R. major* Alex. (Colorado), a very different fly.

Rhaphilolabis (Plectromyia) reducta, new species.

General coloration (in alcohol) pale brownish yellow, the praescutum indistinctly darker medially; antennae with only eleven segments; wings hyaline, the stigma lacking; cell R_5 petiolate; abdomen with a subterminal darker brown ring.

Male.—Length 4.2 mm.; wing 5 mm.

Described from alcoholic material.

Rostrum obscure yellow; palpi short, brown. Antennae brown, the basal segment paler; flagellum with only nine segments; flagellar segments long-oval, gradually decreasing in size to the end. Head yellowish brown.

Mesonotum pale brownish yellow, the praescutum indistinctly darker medially; scutal lobes slightly darkened. Pleura yellow. Halteres pale, the knobs brown. Legs with the coxae and trochanters light yellow; remainder of the legs pale brown, the tibiae a little darkened at the tips. Wings hyaline; stigma lacking; veins brown. Venation: R^S comparatively short, strongly arcuated; petiole of cell R_5 long, subequal to the basal deflection of R_{4+5}; outer deflection of R_2 perpendicular or nearly so, close to the tip of R_1; cell M_1 lacking, as in the subgenus, petiole of cell M_3 longer than this cell; basal deflection of Cu_1 a short distance beyond the fork of M. very faint, without macrotrichiae.

Abdominal tergites light brown; sternites more yellowish; segments seven and eight dark brown. Male hypopygium with the pleural appendages short, stout, the tips blunt; one appendage is more slender, near the tip provides with several spinous setae, the other appendage very short and stout with the distal and blunt, set with several short spines and about two long, delicate bristles.

Habitat.—Idaho.

Holotype, ♂, Moscow Mt., July 25, 1920 (R. C. Shannon).

Paratopotype, ♂.

This small fly presents an appearance that is very similar to the type of the subgenus Plectromyia except that the cell R_5 is petiolate. The reduction in number of antennal segment is very interesting and difficult of explanation. Within the group Dicranotae there is now found a range of from eleven to

fifteen antennal segments (11 in *Rhaphidolabis reducta;* 12 in *Rhaphidolabis subsessiles,* and *Dicranota nipponica;* 13, the normal number for the group; 14 in *Rhaphidolabis flavibasis;* 15 in *Rhaphidolabis fascipennis* and other Oriental species).

Dicranota rogersi, new species.

General coloration gray; mesonotal praescutun with three broad dark brown stripes; antennae of male elongate; wings faintly tinged with brown; stigma dark brown; a paler brown seam along the cord; cell M_1 normally present; cell 1st M_2 open by the atrophy of *m*. male hypopygium with two subequal pleural appendages; the chitinized blade at base of pleurite with the stem less elongate than in *D. eucera.*

Male.—Length about 5.8 mm.; wing 6.6—7.5 mm.

Female.—Length about 7.5 mm.; wing 9.3 mm.

Rostrum brown, grayish pruinose. Antennae with 13 segments, in the male very long, if bent backward extending nearly to the base of the third abdominal segment; first scapal segment obscure reddish; remainder of antennae dark brown; flagellar segments elongate cylindrical. Head dark brown, the vertex adjoining the eyes broadly yellowish gray.

Mesonotal praescutum with a yellowish gray pollen, with three conspicuous dark brown stripes, the broad median stripe very indistinctly split anteriorly by a capillary pale line; interspaces with erect yellow setae; scutum yellowish gray, the centers of the lobes dark brown; scutellum and postnotum light gray. Pleura gray. Halteres pale, the knobs slightly darkened. Legs with the coxae pale, with a sparse grayish pollen; trochanters obscure yellow; femora dark brown, yellowish basally; remainder of legs dark brown. Wings faintly infuscated; stigma conspicuous, dark brown, occupying cell 2nd R_1 and the distal end of cell Sc_1; paler brown seams along the cord and at the origin of R_s; veins dark brown. Venation: S_c long, extending to slightly beyond r; S_c far before fork of R_{+}, the distance a little greater than that section of S_c beyond R_s; R_s moderately long, angulated at origin; R_{2+3} about equal to the deflection of R_2; *r* rather indistinct; R_3 less than its own length from the tip of R_4, entirely provided with macrotrichiae; cell M_1 present in normal individuals; cell 1st M_2 open by the atrophy of m; petiole of cell M_2 a little shorter than the cell; basal deflection of Cu_1 about one-half its length beyond the fork of *M*.

Abdominal tergites brown, with about the posterior half of each segment paler brown; sterites a little paler than the tergites. Male hypopygium with the pleurites short and stout, the caudal lateral angle produced into a short, blunt lobe; two sub-equal pleural appendages; outer appendage fleshy, provided with several long setae; inner appendage subchitinized, with a patch of long, erect setae on the proximal face at the base and a group of short setae on the outer face near the tip: at base of pleurite a chitinized blade that is produced into a beak-like structure with the point directed laterad.

Habitat.—Michigan.

Holotype, ♂, Gogebic County, August 17, 1920 (J. S. Rogers).

Allotopotype, ♀.

Paratopotypes, 8 ♂♀.

Type in the Collection of the Museum of Zoology, University of Michigan.

Dicranota rogersi is named in honor of my friend, the collector, Mr. J. Speed Rogers. It is most closely allied to *D. eucera* O. S., in the elongate antennae of the male sex. From this species it differs in the normal presence of cell M_1, the dark stigma and the details of structure of the male hypopygium, as the subequal pleurites.

A NEW PAPAIPEMA FROM DELAWARE (Lepidoptera, Noctuidae)

BY HENRY BIRD AND FRANK MORTON JONES.

(PLATE VI)

Although a collecting trip through peninsular Delaware and Maryland in July 1920 did not have the genus *Papaipema* as its primary object, the possibility of turning up interesting material in this group was well in mind, so that when our car stopped in a promising bit of low woodland along the DuPont Boulevard, a dried stalk in the roadside herbage attracted immediate attention. Investigation showed it to be not one of the recognized food plants of the group, and as the contained larva was not of that almost ubiquitous species, *cataphracta*, a vigorous search was begun for more. In half an hour, more than thirty infested branches had been gathered, and it was apparent that we were dealing with a species whose life history had been unrecorded, and which possibly was new to science. All this was done at very considerable expense to clothing and bodily comfort for the foodplant is that thorniest inhabitant of our woods, *Aralia spinosa*, which as a small tree along the edges of woods and in thickets bordering woodland streams, with its great frond-like leaves and immense flower-panicles, is a conspicuous feature of the flora of southern Delaware. We had too, the unique experience of gathering *Papaipema* larvae from high over our heads, instead of grubbing them out of root-stocks or the fleshy stems of perennial herbs. The tunnels of this insect, in the thick branches of *Aralia*, are of large diameter, beginning at or near the terminal bud and extending downward through the pithy annual growth, often into the older wood below; gummy exudations mixed with blackened frass mark the entrance to the burrow, and the terminal shoot usually dies and shrivels, a hanging cluster of dead leaves often further advertising its location; adventitious shoots from below the point of injury sometimes bear stunted flower-panicles.

In our breeding-cages, pupation occured more frequently in the larval burrows, rather than in the ground, and another trip was made in early September, in the full expectation that pupae would be found in abundance. Dozens of the typical burrows in the branches of *Aralia* were found, but not one of them contained either larva or pupa, and we were forced to conclude that under natural conditions pupation takes place in the soil, not in the branch of the foodplant. A tabulation of our eastern species of the genus, together with the large size of the *Aralia*-feeding larvae, indicated Dyar's *nephrasyntheta* as the probable identity of our find; but the emergence of the first moth showed that we had, not the anticipated *nephrasyntheta*, but an undescribed species. In this genus, where foodplant association has apparently been a prime factor in the differentiation of so many closely related species, a name derived from that of the foodplant is especially appropriate, and we therefore propose for this insect the name,

Papaipema araliae n. sp.

Head smooth on fons, antenna simple (minutely ciliate under magnific-

ation) with little sexual disparity and set in a tufting of whitish scales. Thoracic vestiture yellow overlaid by longer, purple-brown scales, the prominent anterior tuft has the long purple scales predominant, the yellow standing out strongly on the tegulae and dorsal area, here margined with purple.

Primary proportionately broad, of the typical maculation; the chrome yellow ground color is overlaid and much obscured with purple-or reddish-brown powderings, deepest on the veins and productive of a rather tawny effect. At the extreme base a dot of yellow or whitish scales, the basal spot is yellow, the basal line double, from which outwardly a yellow *dot* appears on the median vein; the basal area remaining appears as an irregular purplish band, bounded outwardly by the sinuous, double, antemedial line; the median field is evenly and entirely of one shade of yellow, upon which the powderings appear more dense in individual cases; the median shade line is prominently drawn in brown, angles at the lower corner of reniform and has a course thence straight to the inner margin, with a tendency to be denticulate between the veins. The orbicular is a rounded white spot, dotted or cut centrally with a few yellow scales; the claviform is composed of two smaller spots, with the upper minute and either white or stained with yellow, and the lower one pure white. The reniform is the usual combination of broken spots, mostly yellow but with some white appearing in varying degree. The post-medial line is double, excurved past the reniform, thence nearly straight to inner margin. Sub-terminal area glistening purplish, defined from the terminal space by the very denticulate sub-terminal line, and the latter area more yellowish especially at the apex where the bright yellow ground again shows. Fringes are lustrous purple-brown.

Secondary is of a much paler yellow, more or less suffused with a rosy flush, a faint median line and sub-terminal banding appearing in darker tone; the fringes paler than primary. The undersides of all wings are of similar hue to the secondary, a median line appears and stipplings of purple-brown are densest on costal margins. The abdomen is of same colour as secondaries, the usual tuftings appearing. Normal expanse, 38 to 45 mm.

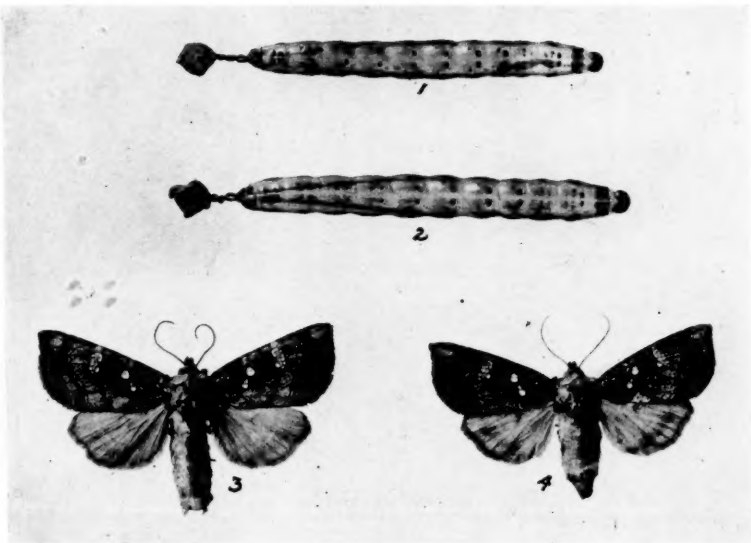
The genitalic structures of the male conform to the conventional pattern, being similar to *marginidens* and others in detail, The trigonate, spinose area of the cost has the lower angle produced into a long point (called the pollex by Pierce) and this exceeds the curved, thorn-like harpe, which has the usual array of fine teeth posteriorly.

Five males and three females are under examination; one male type and One dwarfed example not fully typical. Emergence for the series, Sept. 24 to 30, 1920.

Type locality, Sussex County, Delaware.

The larval habit evidently conforms to the usual happenings in the genus; the hybernated egg doubtless gives up its larva the latter part of May, the growth proceeding as with allied species.

Larva. Penultimate stage: Belong to that section of the genus where the first four abdominal segments appear as a dark girdle, with the continuous dorsal and sub-dorsal lines broad and well defined in yellowish white, excpt where the latter are broken at the girdle, this species might be well selected as typifying what *Papaipema* attains in its best showing of tubercle arrangement and the attributes of its congeners.



PAPAIPEMA ARALIAE, NEW SPECIES

(See Page 137)

Fully normal upon all points, its individuality is yet shown in the uniformity and large size of tubercle I on all abdominal segments. This is about three times the size of a spiracle and equals IV, ordinarily the largest general plate. On joint ten, the evanescent IVa becomes the largest lateral plate of the five here surrounding the spiracle. The anal plate is normal, brown.

Last stage: More of the early colouring is retained at this time than usual, the dull pinkish ground colour giving definition to the pale yellowish lines, which remain as before. Head shining brown, with blackish shade at ocelli; width, 3.25 mm. Body robust smooth, cylindric, livid; setae weak. Onjoint one the cervical shield is wider than head and is margined with black laterally. On joints four, five and six tubercle I is reduced; on ten the same arrangement holds as formerly, and all tubercles are indicated by blackish plates. The spiracle on joint eleven is not enlarged, as it is with the fern feeders. Lengths, 52 and 56 mm. for the stages respectively.

The pupa is correspondingly robust, shining brown and active; there is no frontal development and the cremaster consists of two separate and slightly divergent, curved hooks. The transformation is made in the ground after a rather lethargic resting period, the date of leaving the burrow being from Aug. 10 to 25, so far as could be determined.

A Tachinid fly claimed a large percentage of the observed larvæ, and doubtless is a regular check in this case, as with others. It seems to be, according to Dr. J. M. Aldrich, *Masicera seniles* M.

With the full evidence at hand there is no question as to the standing of this as a distinct species. There is, however, the question yet open as to what one of the species Guenee's type of *rutila* may finally fit in with. Drawings of that type indicate a narrow winged, yellow form, with brightly white stigmata, and there seems no fear of duplication in the case of *aralix*. Serial position near *merriccata* and *arctivorens* may be accorded it.

Our specimens of *araliae* were collected in the woodlands bordering the DuPont Bouvelard, beginning about two miles south of Ellendale, thence southward wherever the foodplant occurs in abundance, for a distance of about fifteen miles. The wide southern and western distribution of the foodplant (Pennsylvania to Florida and Texas) makes it probable that the associated insect, may also prove to be a widely distributed species with a range possibly approximately that of the plant.

EXPLANATION OF PLATE VI.

Fig. 1—*Papaipema araliae*, penultimate stage larva.
2—*Papaipema araliae*, mature larva.
3—*Papaipema araliae*, male.
4—*Papaipema araliae*, female.

A REVISION OF THE CANADIAN SPECIES OF THE AFFINIS GROUP OF THE GENUS TABANUS (DIPTERA).

BY J. MCDUNNOUGH, PH.D.
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In connection with the preparation of a complete list of Canadian species of the genus *Tabanus* it became necessary to revise thoroughly the existing iden-

*Contribution from the Entomological Branch, Dept. of Agriculture, Ottawa.

tifications in the Canadian National Collection. It soon was evident that in the *affinis* group, which is essentially a northern one, there were a number of closely allied forms, capable apparently of separation on structural details of palpi, antennae, etc., which heretofore had been lumped under a single specific name.

In anticipation of a more extended work on the entire genus and with a view to clearing up the various nomenclatorial tangles in the group, I offer the following notes on the various Canadian species, accompanied by a key, based on a study of the structural characters of the females only. Owing to the relative scarcity of the males and the difficulty of definitely associating them with the correct females I am unable at the present time to give satisfactory characters for this sex. I have been in constant correspondence with Prof. Jas. Hine in regard to the correct application of many of our older names and I am pleased to state that in every instance we agree as to the species to which such names should be applied. Miss G. Ricardo has also compared for me a good deal of material with Walker's types in the British Museum and thus enabled me to definitely place several of his heretofore unrecognized species. To both these workers my hearty thanks is due. I am also greatly indebted to Mr. E. P. Vanduzee, San Francisco, Calif., Prof. A. L. Lovett, Corvallis, Oreg., Prof. R. A. Cooley, Bozeman, Mont. and Mr. J. B. Wallis, Winnipeg, Man. for loan of material.

The *affinis* group, as understood in the present paper, comprises those species in which the greater part of the first four abdominal segments is red or orange-red of various shades with a varyingly broad blackish dorsal band. The species extend across the entire northern half of the American continent reaching southward along the Atlantic Coast, down the Rocky Mountains and through the Cascades to the Sierra Nevada Mts. Further collection, especially in British Columbia will probably increase the number of known species; at the present time I am able to differentiate thirteen species.

Key to Species.

FEMALES.

1. Abdomen with 1st segment laterally orange or reddish.....2
   Abdomen with 1st segment laterally black.....12
2. Wings with all cross-veins distinctly clouded with brown .....*lasiophthalmus* Macq.
   Wings unclouded or with only bifurcation of third vein clouded.....3
3. Palpi thin, not swollen at base of 2nd joint.....4
   Palpi shorter, with base of 2nd joint noticeably thickened.....9
4. Subcallus normally denuded; front very broad.....*captonis* Mart.
   Subcallus normally not denuded.....5
5. Small species, 10 mm., very thin palpi, antennae with 3rd joint scarcely excavated basally.....*minusculus* Hine.
   Larger species, 14mm., or over.....6
6. Large species, 17-19mm; antennae with 3rd joint very strongly excavated basally 7
   Smaller species, 14-17mm; antennae only moderately excavated at base..8
7. Palpi deep orange-yellow; abdomen laterally deep orange-red..*affinis* Kby

Palpi paler; abdomen laterally yellow-brown.....*californicus* Mart.

8. Palpi long and thin, deep orange; length 14-15mm.; basal portion of third antennal joint chunky.....*trepidus* McD.
   Palpi shorter and thicker, pale creamy; length 15-17mm.; basal portion of 3rd antennal joint rather slender.....*haemaphorus* Mart.
9. Subcallus normally denuded; palpi chunky, pale creamy.....*nudus* McD.
   Subcallus not normally denuded.....10
10. Antennae red with third joint moderately excavated; front narrow and coarctate; palpi moderately swollen.....*epistates* O. S.
    Antennae black with 3rd joint narrow and not noticeably excavated; front moderately broad; anterior branch of vein 3 frequently with basal stump 11
11. Wings with bifurcation of 3rd vein clouded with brown...*sonomensis* O. S.
    Wings with no cloud on bifurcation of third vein.....*phaenops* O. S.
12. Subcallus denuded, small species, 13mm.....*rupestris* McD.
    Subcallus not denuded, larger species, 16mm.....*atrobasis* McD.

Tabanus affinis Kirby. This is the largest species in the group and apart from size is best recognized by its long thin palpi of a deep orange color and the strong dorsal excavation at the base of the third antennal joint. It extends completely across the Dominion of Canada and in the East at least is not liable to be confused with any other species. In British Columbia it is rather rare and the following species, as well as *haemaphorus* Mart., have masquaraded under this name. According to Miss Ricardo triligatus Walk. is a sure synonym.

Tabanus californicus Marten. This name has been sunk as a synonym of *epistates* O. S. by Hine (1904, Ohio Nat. V, 236). Marten's types are unfortunately not in existence but on account of the size mentioned in the original description (17mm.) and the fact that it is very doubtful if the true *epistates* occurs as far south as California, I am inclined to associate this name with a large Pacific Coast form closely allied structurally with *affinis* but differing very decidedly in the lateral coloration of the abdomen. In *affinis* the color is a rather rich orange-red whilst in the present species it is yellow-brown, shaded with lighter yellow along the segmental margins. I have seen two specimens from Oregon and the Canadian National Collection contains a series of six females taken by Dr. S. Hadwen at Mt. Lehman in the Lower Fraser Valley, B. C. Marten's original description particularly mentions this yellow-brown color and the remainder of his description fits in so satisfactorily with the present species that I have adopted the name without much hesitation.

Tabanus haemorphorus Marten. Hine has sunk this name as a synonym of *sonomensis* O. S. but I cannot accept this. The true *sonomensis* is a comparatively small species, whereas the size of *haemaphorus* is given by Marten as 16-18mm. What I consider to be this species has been generally passing under the name of *affinis* Kby. It is apparently the commonest British Columbia species, occurring in May and June and differs from the true *affinis* in the shorter and paler colored palpi and the less excised 3rd antennal joint; it is also somewhat more slender in build. Besides the British Columbia series in the National Collection I have seen specimens from Oregon.

Tabanus captonis Marten. I agree with Hine's identification of this species,

with *comastes* Will. as a synonym. As stated (1904, Ohio Nat. V, 235) the species is readily separated by its wide front and denuded subcallus.

The species is quite common on Vancouver Island and on the mainland of British Columbia in the Lower Fraser Valley.

Tabanus lasiophthalmus Macquart. This is the only species of the group in which all the cross-veins of the wings are decidedly tinged with brown, which renders identification quite easy; other features are the denuded subcallus and the presence of pale yellowish oblique stripes laterally on the reddish areas of abdomen. It is just possible that occasional specimens occur in which the usual maculation of the wings is absent; one or two specimens before me which lack such maculation seem in all other respects to agree with normal specimens of *lasiophthalmus*. The species extends across the entire continent.

Tabanus trepidus, sp. nov. ♀. Palpi long, thin, not swollen at base and tapering to a fine point, deep yellow-orange, rather heavily clothed with black hairs; antennae reddish, the dorsal and terminal portion of 3rd. segment blackish; 3rd segment rather chunky and only moderately excised dorsally at base; subcallus not denuded; front dull yellowish, moderately broad with callosity and a spindle shaped patch above it shiny black; thorax dull blackish with the usual pale obsolescent stripes and the antealer tubercles slightly tinged with reddish; abdomen much as in lasiophthalmus with lateral areas of first four segments broadly reddish-orange, with distinct traces of pale oblique yellow stripes, and with a black dorsal band, widest on 1st segment; ventrally yellow-orange, more or less shaded with smoky, terminal segments blackish; legs blackish, the proximal half of all tibiae tinged with orange-yellow; wings dull hyaline, costal cell and area surrounding longitudinal veins in basal half of wing tinged with brown.

Length 14-15mm.

Holotype. 1♀, Ottawa, Ont. (June 26th., W. Metcalfe) in Canadian National Collection.

Paratypes. Numerous ♀'s from Shelburne, N. S. (July 1st., A. Gibson); Harcourt, N. B.; Ottawa, Ont.; Ft. Coulonge, Que.; Aweme, Man. and Peachland, B. C., in Canadian National Collection.

The species has been frequently confused with *epistates* O. S., but can at once be differentiated by the long thin palpi; from *affinis* it differs in its smaller size and less excavated third joint of the antennae.

Tabanus minusculus Hine. A single specimen of this small species is in the Canadian National Collection, kindly identified for me by Prof. J. Hine; it was captured at Ottawa, (Mer bleue, 26th., June, 1904) by Mr. W. Metcalfe. The palpi are extremely thin and the antennae show scarcely any excision of the basal portion of the 3rd joint. The subcallus is covered with a fine ochreous pollen and the callosity is brownish, extending up the front as a thin black line to the ocelligerous tubercle which is also brown.

Tabanus epistates O. S. Several species have been confused under this name which would account for Hine's statement in his paper on Western Tabanidae (1904, Ohio Nat. V, 236). Osten Sacken's characterization is so clear, however, as to leave no doubt in any mind as to the species to which the name should be applied. The narrow coarctate front is quite characteristic; the palpi are moderately long, pale ochreous and distinctly swollen at the base, the subcallus

is not denuded and the antennae are generally almost entirely red with base of 3rd joint rather chunky and moderately excised. The pale oblique stripes on the abdomen, noted in *lasiophthalmus* and allied species, are not present in *epistates*. The species appears to be common throughout Manitoba Saskatchewan, and the Hudson Bay region, rather rare in Ontario, Quebec and New Brunswick and decidedly rare in British Columbia; the only two specimens from this latter region which I should incline to place under this name were captured at Vernon and Cranbrook; both are rather larger than normal and have the antennae more suffused with black than is generally the case.

Tabanus nudus, sp. nov. This species has been so generally confused with *epistates* that a comparative description, indicating the points of distinction, is all that is necessary. The front is distinctly broader and the subcallus is denuded; the palpi are shorter and basally more swollen; the antennae are blacker apically, the basal portion of the 3rd joint is rather wider and the finger-like dorsal projection of the 2nd joint is much longer. The pale yellow lateral oblique stripes on the abdomen are present and only slightly less distinct than in *lasiophthalmus*. Length 15mm.

Holotype. 1♀, Ottawa (Mer bleue, June 1st., 1908), in Canadian National Collection.

Paratypes. Numerous ♀'s from New Brunswick (Fredericton, St. Stephen); Ontario, (Ottawa, Hastings Co.,); Manitoba, (Aweme); Saskatchewan and British Columbia. (Mt. Lehman).

The species is much commoner and more wide-spread than *epistates*.

Tabanus sonomensis O. S. The true *sonomensis* is a rather small species, confined, as far as I know, entirely to the Pacific Coast region. The British Columbia records I possess for the species are all from Vancouver Island but it probably will be found in the Lower Fraser Valley as well. Apart from its smaller size it may be distinguished from the preceding species by the entirely black antennae with a narrow thirdjoint, scarcely excised at base. There is a decided tendency towards a stump at the base of the anterior branch of the 3rd vein, the cross-vein being generally decidedly tinged with brown. Hine (1904, Ohio Nat. V, 244) has treated several forms under the name *sonomensis* but his remarks in the first paragraph are applicable to the true species.

Tabanus phaenops O. S. The species is very closely allied to the preceding and I have not yet decided to my entire satisfaction whether the two can go definitely separated. Typical phaenops possesses almost blackish palpi in contradistinction to the pale ochreous ones of *sonomensis* but this character seems variable; Oregon specimens and ones from Laggan, Alta., which agree in other respects, have pale palpi. The lack of the brown spot on the cross-vein seems more characteristic and for the present I am using this feature to separate the two forms. The antennae are similar to those of *sonomensis* and the reddish area of the abdomen seems variable in its extent. The species is decidedly rare in Canada and more material will be necessary to definitely decide its status.

Tabanus rupestris, sp. nov. ♀. Palpi moderately long, very little swollen at bsae, dull orange, at times considerably tinged with smoky; antennae thin, reddish, the distal half of 3rd joint black, very slight excavation dorsally at base of 3rd joint; subcallus denuded, shiny black; callosity shiny black with wedge-shaped black patch above it; front with yellowish pollen and black ocelligerous tubercle;

thorax blackish with the usual faint, pale lines; antealar tubercle black; abdomen dorsally with 1st segment almost entirely black, slight traces of orange being visible on the extreme lateral posterior area; a broad (2mm.) black dorsal band crosses segments II-IV, the lateral areas being deep orange-red, remaining segments black; slight traces of a paler flesh-colored oblique stripe on the red area of segment II; ventrally orange-red the posterior border of the 1st segment and the last three segments blackish; legs with all femora black, anterior tibiae tinged with orange proximally, other tibiae entirely dull orange; wings hyaline with costal cell brownish and a faint brown cloud at the base of the anterior branch of 3rd vein. Length 14mm.

Holotype. 1♀, Gallatin Co., Montana (July 14th., 7500 ft) in Canadian National Collection.

Paratypes, 2♀'s, Gallatin Co., Montana (July 27th., 5500 ft.) in Collection of Montana Agr. Coll.; Cowley, Alta. (Sept., R. N. Chrystal) in Canadian National Collection.

The species closely resembles *phaenops* but differs in the denuded subcallus, the redder antennae, the broader black area on 1st abdominal segment and the cloud on the outer cross-vein; none of the specimens before me shows any trace of a stump at the base of the anterior branch of vein 3 as is so often seen in phaenops; the extent of the black area on the first segment may be variable and should not be too much relied on as a sole means of separation from *phaenops*.

Tabanus atrobasis, sp. nov. ♀. Palpi orange, heavily clothed with short black hair, not swollen at base; antennae black with 2nd joint and basal portion of 3rd red; dorsal angle at base of 3rd joint obtuse, with little excavation, this whole portion being rather slender; subcallus and front covered with pale yellowish pollen, latter moderately (.5-.75mm.) broad with shiny black-brown callosity extended towards as usual by a fine black line; thorax blackish with the five pale lines as usual and a black antealar tubercle; abdomen with first segment dorsally entirely black except a very narrow line of orange along posterior margin; second to fourth segments laterally orange, shaped somewhat with brownish; a broad (2mm.), black, dorsal band with more or less distinct central row of triangular pale spots situated on rear margin of segments and clothed with pale yellowish hair; last three segments blackish; rear margins of all segments with yellow hair; ventrally dull orange, shaded with smoky and with rear segments entirely black. Legs black, anterior tibiae slightly, other tibiae almost entirely dull-orange.

Length 16-17 mm.

Holotype. 1♀, Mt. Lehman, B. C. (May 30th., S. Hadwen) in Canadian National Collection.

Paratypes. Numerous ♀'s from various B. C. localities (Mt. Lehman, Victoria, Duncan, Courtenay, Royal Oak) in Canadian National Collection.

The species has apparently been confused with both *sonomensis* and *captonis;* the entirely black first abdominal segment seems quite characteristic and separates *atrobasis* from both the above mentioned forms; it is considerably larger than *sonomensis* and lacks the denuded subcallus and chunky third antennal joint of *captonis*. The species extends south into Oregon, a number of specimens having been received from Prof. Lovett, labelled either *sonomensis* or *epistates*.